

# Blood screen Truth

by Alexander Lerchl

**The purpose of this short article is to describe the blood, its components and functions, to depict the diagnoses and methods used to determine blood counts, and to point out criteria and possible weaknesses of analyses. However, it cannot be the aim to provide a complete overview of corresponding literature or a complete discussion of pathophysiology of individual blood components.**





# Findings in EMF research: and fiction

## 1. Preface

The concern of large parts of the population about negative health effects from mobile radio transmission masts (base stations) and end devices (mobile phones) is an enduring ingredient of political discussion and there is often considerable resistance against the deployment of new base stations. Existing fears – which are unfounded in my opinion – grow due to “investigations” allegedly proving considerable effects from base stations, such as general psychological or physical discomfort, headaches or sleeplessness, up to malignancies such as brain tumors or leukemia. Lay people mostly are unable to critically assess such “studies”, which quite often do not meet requirements of scientific research. Public skepticism, often going hand in hand with a basic negative attitude toward all technological innovation, is enforced by “experts” who create the impression that you can generalize individual cases and thus purposely use the fears of the population to their advantage.

The focus is on changes in blood counts allegedly associated with leukemia. Conclusions such as: *“This [the result of an investigation done in Korbach] showed that blood counts of people living in urban areas with many transmission masts were different from those*

*of people from less exposed areas [...]. There was an increase in immature red blood cells in the blood counts of exposed people e.g. from Strother Straße”,* are not objective and scientifically valid, since an increase or decrease in certain parameters is normal to a certain extent (within so-called standard values) or depend on other parameters that cannot be seen as evidence of pathological causal chains in general, either (“mobile radio causes changes in blood counts”). We can and will not deny that there is the *possibility* that radiofrequency electromagnetic fields might have effects. But as long as investigations based on scientific standards, actually confirming such suspicions or at least providing a certain evidence of effects, are lacking, there is reason to remain doubtful about such claims.

## 2. Blood functions

The blood has a number of important functions that can be classified as follows:

- A Supply of tissue with water and electrolytes via the fluid
- B Supply with oxygen and transport of carbon dioxide via erythrocytes
- C Defense against infectious agents and foreign substances via the rest of the cellular components and dissolved proteins
- D Blood coagulation and wound closure.

Life would be impossible without these functions. Not only has the blood the ability to fulfill the above mentioned tasks, it is also capable, to a certain extent, to change its composition so as to adequately respond to changed environmental conditions. A well-known example is the increase in the number of red blood cells (and thus an increase in water content) at small oxygen concentrations in the breathing air over



a longer time period, ie at large altitudes. Sometimes, however, the blood responds too strongly and there is an overshoot of reaction in the form of allergies or even lethal shocks.

## 3. Components

### a Non-cellular

#### i Water and electrolyte

With 56%, the so-called plasma is the main component of the blood. It consists of 90% water and electrolyte dissolved therein (chloride, bicarbonate, phosphate, sodium, potassium, calcium, magnesium, etc.). Water as well as electrolyte are of direct relevance to the functioning of the organism. Whereas slightly elevated or lowered water levels are tolerated over a certain time, even small deviations in the required electrolyte content can have dire consequences (e.g. for cell excitability) very quickly. Therefore, the reference range for electrolytes (see below) is very narrow.

#### ii Low-molecular substances

The most important low-molecular substances in the blood are blood fats resp. fatty acids, sugar and amino acids from which cells derive energy or which they need for the synthesis of proteins or other substances. Further, the blood transports metabolism decomposition to the liver, the lungs or the kidneys and the digestive tract for disposal. Low-molecular substances are also non-protein hormones, e.g. catecholamines (adrenaline, noradrenaline), steroids, melatonin and glucocorticoids.

#### iii Proteins, antibodies

The plasma contains approx. 8% of dissolved proteins, one half of which is fibrinogen that is involved in blood coagulation. Other proteins are involved in the transport of specific substances which are not soluble or difficult to dissolve in water, e.g. iron (bound to transferrin), and protein hormones (e.g. LH, FSH, prolactin, TSH, GH). Antibodies of different

classes (IgM, IgG, IgA) are another important component of the blood. They are part of the complicated human immune system that also comprises cells (see below). They are formed from the reaction with different antigens. These can be viruses, bacteria, fungi or parasites, but also certain pollens, metals or synthetic substances which the body responds to with immune reactions.

### b Cellular

All blood cells originate from a single type of cells: haematonic stem cells. Stem cells are located in bone marrow. As a consequence of the influence of local and endocrine (hormone-like) factors, stem cells divide and are first (besides forming new stem cells) differentiated into other, so-called pluripotent stem cells, which in turn become different blood cell types. Though the number of cells of different cell types in the healthy organism is limited, differentiation cannot be described as a simple mathematical equation.

#### i Reticulocytes and erythrocytes

Erythrocytes (red blood cells) are the only blood cells losing their nucleus when reaching maturity. An advantage of this is the increase in oxygen absorption per cell, but otherwise it has no functional relevance (erythrocytes of birds do have a nucleus). The cell shape is that of a flat disc with a bulging rim, ie with a relatively large surface. Due to its malleability, it allows excellent passage through narrow capillaries. Erythrocytes contain large amounts of hemoglobin – red pigment – which is responsible for oxygen transport. In its oxygen-enriched state, hemoglobin (or blood collectively) is bright red, in its oxygen-poor state it is dark red. Further, erythrocytes transport carbon dioxide from the tissue to the lungs via certain biochemical transformation processes, where it is emitted by breathing. The (nucleus-containing) erythrocytes in this prestage are called “orthochromatic erythroblasts”, which, over the course of the subsequent develop-

ment, decrease the size of (“condensate”) the cell nucleus and finally eject it. Ribosomes (cell organelles) remaining in these young erythrocytes for a certain time period are linked to each other forming a web-like structure. Reticulocytes are named after them. Reticulocytes quickly transform into normal erythrocytes, therefore their number is small.

#### **ii Lymphocytes**

There are thymus-dependent (T-) and bone marrow-dependent (B- for bone) lymphocytes being responsible for immune responses. Also the so-called “killer cells” with their direct cytotoxic influence belong to this group. Some of these cells have stored information on first-time infections a life long. Specific antibodies are produced which prevent a second infection by the same germ.

#### **iii Monocytes, granulocytes and thrombocytes**

Like erythrocytes, these cell types originating in pluripotent myeloid stem cells, have a number of important functions as part of the immune response against foreign bodies, germs and parasites. Moreover, substances regulating the blood flow are released (by basophilic granulocytes), which, as a rule on site, (ie. where an immune response is needed), leads to increased blood flow and to an influx of other immune cells. Thrombocytes finally are responsible for wound closure by forming aggregats and promoting blood

coagulation. Lymphocytes, monocytes, granulocytes and thrombocytes often are summed up under the term “white blood cells”.

### **4. Diagnosis of pathological changes**

The examination of blood, especially of its cellular components, is an important diagnostic tool for identifying diseases. Even a “simple” infection leads to an activation of the immune system being visible in blood counts. Anemias (lack of blood) caused by iron deficiencies and bleedings can also be identified, as well as blood malignancies, e.g. leukemia. Both cellular and biochemical analyses in general allow a definitive diagnosis. For the large variety of diseases and diagnoses – which cannot be listed in this report – please see the specialist references (Theml et al., 2002).

In all cases, it is important for diagnosis to observe certain guidelines on blood withdrawal, blood processing direct after withdrawal, transport and diagnosis at a special laboratory. As essential is a thorough anamnesis (recording of patient data) for the documentation of prescribed pharmaceuticals or existing diseases. In the following, we will describe a few relevant criteria.

#### **i Quality controls**

Quality control means complying with certain rules and standards to achieve technically accurate mea-



surements of samples and accurate results within certain tolerance margins. Among others this concerns certain device standards, since most analyses today are automated. Moreover it is ensured that all processes and results are documented so data can be retraced to their sources even years later.

Quality control (QC) can be conducted within a laboratory (so-called "internal QC") as well as across different laboratories and a referential laboratory (so-called "external QC"). In accredited laboratories, generally both types are implemented. Internal QC makes sure that samples with known target values (from "pools") produce the same results when repeatedly measured. This is crucial e.g. when there is new staff or new equipment; without QC, creeping and often not detected deviations can occur regularly that may confuse measurements. At external QC, often unknown samples are sent to a laboratory, which have been analyzed or are simultaneously analyzed by a referential laboratory and are then compared to the target values. Valuable conclusions can be drawn from the comparison of results from several test laboratories which are communicated to all participating labs. It often depends on these results whether medical service fees may be charged.

Tests looking for possible changes in blood counts potentially caused by electromagnetic fields should always be performed by accredited, quality controlled laboratories; in the case of before/after tests, preferably by the same laboratory.

## **ii Sample preparation and send-out**

Blood samples for the determination of cellular components ("blood counts") are mostly taken by venous punctation; an EDTA tube is filled with the blood to prevent coagulation. These samples have to be sent out to the laboratory immediately (within 8 hours) and be analyzed there in order to prevent change in parameters. General practitioners use special courier services to transport the samples to the laboratory

within a few hours. In hospitals, laboratories are under the same roof. In addition, blood smears are often evaluated which, when fixated, are preserved for several years.

Further, the following conditions have to be met whenever possible, or deviations have to be recorded:

- 1 time of day of blood taking (because of diurnal variations)
- 2 no food for at least 8 hours ("blood taken on an empty stomach")
- 3 taking the blood with the subject lying down (ideal) or in a relaxed sitting position.

If deviations between two specific states (e.g. with or without electromagnetic fields from base stations) are examined selectively and sensitively, these aspects have to be observed very carefully. Further, both blood samples should be taken in the same practice as well as by the same person, and blood counts should be performed by the same laboratory. Otherwise results are not comparable.

## **iv Manual and automated techniques**

In large laboratories, blood samples are nearly always processed automatically when looking at cellular composition. Advantages are reduced error rates and high turnover; a disadvantage is the large expense. In small laboratories or physicians' practices, blood samples are rarely examined microscopically. The samples (a single drop is sufficient) are mounted on a slide, dyed and examined. In modern laboratories, this kind of manual screening is only used when certain "suspicious" results have to be verified, or if very small quantities (e.g. thrombocytes in small numbers) have to be analyzed microscopically. A semi-quantitative analysis ("many, average, few cells xy") is not useful at all.

## **v Small and large blood count**

The differentiation between small and large blood counts is obsolete today; automated techniques nearly



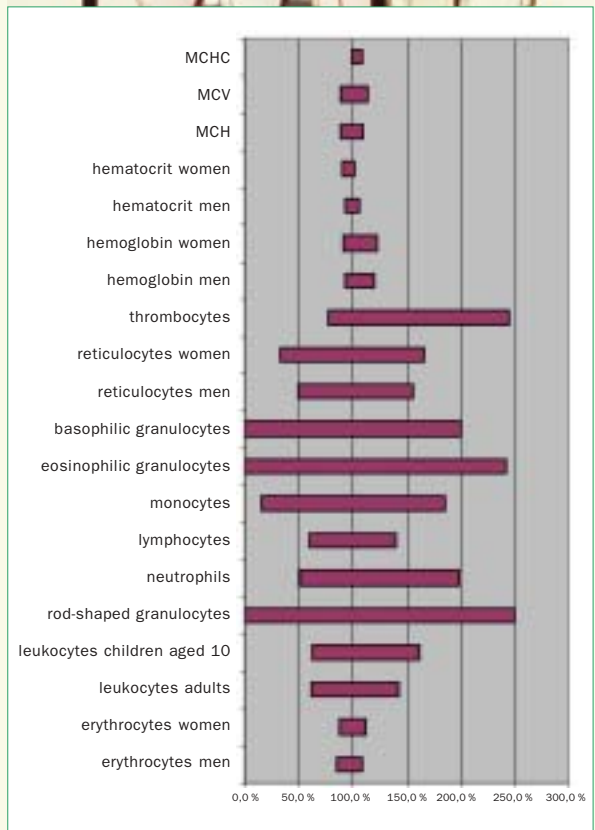
always do complete blood counts. In automated analysis, the additional expense of complete analysis is neglectable. The small blood count (hematocrit, leukocytes, blood decrease) moreover is very rough as a diagnostic tool and not comparable to the conclusiveness of complete results.

### 5. Mean values and standard range

If the blood counts of a large number of people are examined, distribution around a mean value is observed for the different normal parameters. Normal distribution range is defined as the spread within which 95% of single values are found. However, sex and age are seen as important quantities for classification. The widest known difference would be that for erythrocytes. Their number is larger in men than in women. The reason for lower and upper limits of normal ranges not having the same numerical distance to the mean value, is the type of distribution which is not necessarily the normal distribution (Gauss distribution). So, if values are within normal ranges, there is no evidence for a disease.

However, distributions for each parameter are estimable and thus are a relevant quantity. If e.g. specific cells are within the normal range but perform a “left shift” or a “right shift”, this can be important evidence of an existing disease (e.g. old versus young cells). Further, certain combinations of characteristics within the normal range (“diagnostic constellation”) can also suggest a specific disease. In either case it is not permissible and dubious to interpret single changes within the normal ranges as an effect. The change in values can be purely coincidental; moreover, even automated analyses cannot be exactly replicated. Furthermore it is known that nutrition also can lead to a change in blood cell numbers.

In order to demonstrate the actual spread of some relevant blood counts, we have transformed normal ranges into percentages, based on absolute numbers (Theml et al., 2002). It is evident that some



**III. 1: Blood counts (without antibodies) and variation of values (column width = standard ranges) around the mean value (100%). The original data are taken from Theml et al., 2002. MCH = mean cell hematocrit, MCV = mean cell volume, MCHC = mean cell hemoglobin concentration**

parameters (e.g. hemoglobin) are relatively invariable, whereas others (especially granulocytes) considerably vary around the mean value without there being necessarily a disease.

For reticulocytes, these ranges reach from 33 % (women) or 50 % (men) to 156 % (men) or 166 % (women). But different normal ranges (in % of total number of erythrocytes) are given, dependent on the respective source: Theml (2002) indicates a lower value of 0.8 %, and 2.5 as the upper value for men resp. 4 % for women, whereas e.g. the AOK (health insurance agency) indicates 0.5 % to 1.5 %, and the University Hospital of Zurich indicates a range of 0.4 % to 2.5 %. Mostly, the normal range lies between 0.5 % and 2.5 %. Aside from the differences between techniques, this is above all due to reticulocytes not being **per se** a diagnostically relevant quantity. They have always to be evaluated in association with the number of erythrocytes or the hemocrit value. So, at low hematocrits, much larger numbers of reticulocytes are perfectly normal, since more blood is formed. In this case, we speak of a “dynamic” parameter.

## 6. Previous results from the search for EMF effects

There is no verified evidence of blood system damages caused by mobile radio non-thermal effects in scientific literature. This scientifically uncontroversial fact (see review of Black and Heynick, 2003) is simply ignored by critics of this technology. Instead, individual findings within standard ranges are claimed to be generally valid results that are used to alter public perception by constant repetition.

In my opinion, public concern about adverse effects from mobile radio electromagnetic fields is understandable for a number of reasons:

- network operators as well as manufacturers of end devices and base stations initially refused to engage in open discussion with the population about its fears or did not take them seriously:

- the concern arising when mentioning blood count changes is increased by the association with leukemia (such as purported EEG changes often are linked with brain tumors);
- blood count determination can be done at all times, even though it has to be paid for at one's own expense (in the case of EEGs, this is more difficult to do and more expensive);
- lay people cannot distinguish between “changes” in the blood count and normal variations;
- finally, mobile radio technology critics use conclusions such as the following, which cannot be accurately assessed without expert knowledge:

“Von Klitzing [Dr. med. Lebrecht von Klitzing, formerly University of Lübeck] writes about symptoms occurring at 1 nW/cm<sup>2</sup>: It generally begins with sleep disorders and concentration problems, then with individual characteristics there is cardiac disrhythmia, ear buzzing, allergic reactions up to a changed blood count. This latter syndrome of immature erythrocytes (red blood cells), especially observed in children, is reversible within a few days when distancing oneself from the source of exposure, e.g. by switching off a phone.”

Or:

“Observations in daily life and research provide increasing evidence and proof of the fact that low-frequency pulsed radiofrequency fields are partially responsible for the following health disorders and can trigger them: sleep disorders, anxiety, tenseness, nervousness, depression, headache, ear buzzing (tinnitus), concentration and memory disorders, eye irritation and glaucoma, learning disorders, increased blood pressure, cardiac disrhythmia, sudden death from heart disease, migraine, dizziness, increase of amalgam contamination, potency disorders, fertility disorders, blood count changes and disorder of blood formation, *accelerated cancer growth, constant fatigue and exhaustion, listlessness, allergies, Morbus Alzheimer and immune deficiency.*” (emphasis by the authors)

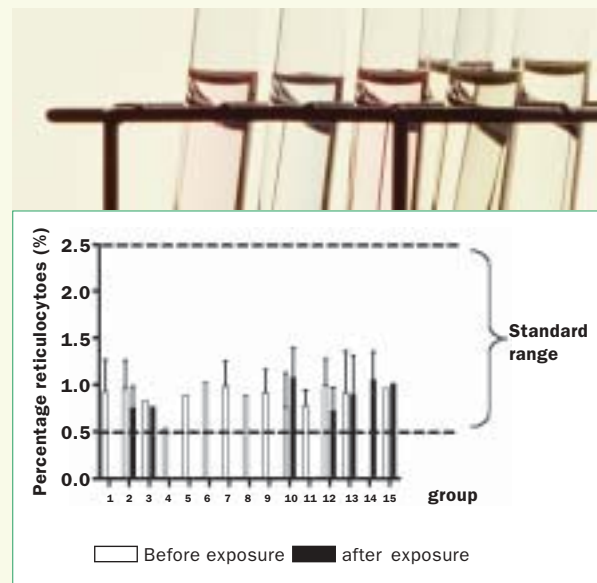


Both taken from: Das Damokles-Schwert über unseren Köpfen (A Damocles' sword above our heads), Benjamin Seiler and Siegfried Zwerenz, Bürgerwelle e.V.; <http://www.buergerwelle.de/d/doc/presse/hfartikel.htm>

These generalizations are neither scientifically verified nor can they be confirmed in any way. There have been proposals to centralize and analyze data general practitioners have collected, partially over several years. Regrettably, this plan was not carried through, so study results are not available.

There is a lack of useful data too regarding the repeatedly claimed changes in blood counts. Dr. Dietrich Arendts from the Initiative Appenheim writes: *"The conclusiveness of the blood count as an indicator of so-called EMF effects is clearly confirmed in literature. Reticulocytosis of more than 1.8% was [...] described there."* With 1.8%, this "reticulocytosis" is within the standard range (0.5 to 2.5%). Further, this article refers to test series performed in cooperation with a renowned laboratory (Bioscientia, Ingelheim). Blood samples of concerned citizens were to be analyzed there and re-examined several years later (after the deployment of a base station). IGUMED (Interdisziplinäre Gesellschaft für Umweltmedizin e.V. - Interdisciplinary Society of Environmental Medicine) played a critical role in these tests. As a member of the Board of Chairs, Dr. Germann, Worms, told us on the phone, on February 16, 2004 that the study could not be evaluated, "since the samples were lost". However, Germann added that, though mean values in current results showed no differences, there was a change in absolute number of reticulocytes in two thirds of the participants, and single cases always said alot! Besides, participants were too few to obtain conclusive results. On February 17, 2004, we contacted the internationally active, accredited laboratory "Bioscientia" ([www.bioscientia.de](http://www.bioscientia.de), contact: Mr.

Kohl). We were told that samples of course had been analyzed and results were sent back to the respective practitioners. Mr. Kohl did not know what happened with the data after this. Another investigation by phone (on February 20, 2004) with the so-called "hese project", where all citizens' groups purportedly collect their data, did not bring about useful results either. No scientist was found so far to analyze the data. Another member of the Board of Chairs of IGUMED told us during a phone call (February 25, 2004) that there was no proof of effects from electromagnetic fields on the blood count yet. Generally, too much research in this field was "carelessly done".



III. 1: Graph showing the values given in the study of Dr. Germann. The graph lists mean values and distributions, as far as contained in the tables

## 7. The study of Dr. med. Peter Germann

The “Preliminary Evaluation based on 1000 tests” – so the subtitle of the study “Influence of mobile radio exposure on reticulocyte maturation” published on the internet in July 2004, was aimed at investigating potential negative effects of mobile radio electromagnetic fields on humans and serving as a basis for further studies. The emphasis was on the number and maturation rate of reticulocytes. These cells are predecessors of erythrocytes being the main component of the blood.

“At present, there might be the necessary and plausible possibility that health damages caused by mobile radio” is associated “with reticulocyte maturation ... [that] can be used as a reliable parameter to prove long term exposure to PEMF [pulsed electromagnetic fields].” The choice of words (“necessary ... possibility”) alone shows that it is not only neutral evaluation that is the aim here, just so the statement: “‘Scientific’ proof of an effect is the main target ... Evaluation of current results therefore is secondary.” In spite of that, the report goes on: “At present, the results of reticulocyte counts done in 498 of 1014 patients demonstrate that there are significant effects in humans caused by pulsating EMF.”

Individual findings and trends in parts of the test groups are clearly emphasized, whereas non-significant results from overall group comparisons are treated rather in few words.

Critical aspects of this study are:

- There is a lack of data regarding field strengths and frequencies before and after “switching on the transmitter”.
- In part, numbers are contradictory, page 3 mentions 10 groups before and 5 resp. 6 groups after switching on the transmitter, however the table lists data of 14 resp. 7 groups; the number of tested volunteers before switching on the transmitter once is 1014, then again 1053, but accord-

ing to the table is 1024; similarly, the number of samples after switching on the transmitter is 440, in the table it is 498; the number of volunteers in group 15 is 65 before and 164 after switching on.

- Normal ranges (not mentioned here) for reticulocytes are 0.5 to 2.5 %, according to the data from specialist literature (see above). The obtained values with an average of 0.87 % (prior to switching on) and 0.897 % (after switching on) are within the standard range, and there is no statistically significant difference. In spite of that, there is the attempt to move individual findings and purported trends into the foreground: “However, there were clear differences during tests of individuals before and after operation. This intraindividual change is observed in all 6 groups.”
- There is no mention of such changes within standard values being perfectly normal and thus not pathological. Conclusions drawn on distribution (“So there was an increase in the total number of reticulocytes in two thirds of the group members ...”) are useless without comparisons to normal distribution.
- Statistical analysis of data is incomplete resp. wrong. For many groups, only mean values are given; ranges of dispersion are lacking. Values given at the foot of tables as “persons total mean value” were obtained by calculating mean values from mean values. This type of calculation leads to wrong results.
- The mean values of single groups and ranges of dispersion are shown in the following graph (as far as given). You can easily see that all mean values are within normal ranges. So, according to internationally acknowledged scientific standards, we can in no way speak of “significant” effects.

The final conclusion that disorder of molecular tertiary and quaternary structure is caused by electromagnetic “phenomena”, has no basis. The powers occurring



in molecules are larger by many magnitudes of order than those of electromagnetic fields as produced by mobile radio devices.

Finally, we should mention critically that an association between the effects observed in this study and deaths resp. serious disease of children is suggested (“By this we can also explain tragic individual cases, where babies or infants fall ill or even die without known cause.”) Conclusions such as this, not supported by scientifically valid facts or evidence, cause unfounded fears in the general population.

The study of Dr. med. Peter Germann is available on the web at:

[http://www.izgmf.de/Aktionen/Meldungen/Archiv\\_04/Germann-Studie/germann-studie.html](http://www.izgmf.de/Aktionen/Meldungen/Archiv_04/Germann-Studie/germann-studie.html)

and

[http://www.izgmf.de/Einfluss\\_Mobilfunk\\_auf\\_Reticulocyten.pdf](http://www.izgmf.de/Einfluss_Mobilfunk_auf_Reticulocyten.pdf).

## 8. Final summary

Despite the lack of scientific proof or even reliable evidence of existing adverse effects from radiofrequency electromagnetic fields in the non-thermal range on the blood system, the opposite, ie the existence of such effects is vehemently claimed by some representatives of citizens’ groups or their roof organizations. Assertions such as:

“... investigations ... [performed on EMF effects] in cells, tissues, animals and humans at least leave no doubt that influences are possible”, or: “The multitude of symptoms associated with such field exposure is long and widely known”, as well as: “90 % of information transport inside the body is done via electromagnetic links ...”, are per se meaningless and empty. Other assertions are more difficult to see through, such as those regarding “effects” after

switching on mobile radio transmitters. Claimed findings are: “coagulation tendency in children younger than 4 years”, “two thirds of participants showed an a decrease in the absolute numbers of reticulocytes, in children up to 80 %”, or “decrease erythrocyte MCHC”.

The given values do not indicate any adverse effects of EMF when considering age dependency and the considerable variations of cell numbers within normal ranges<sup>2</sup>. Fact is, there is no proof nor evidence whatsoever for blood counts being damaged or changed due to the influence of electromagnetic fields complying with legal limits, neither in scientific literature nor in practice. It would be desirable that the “many” data which are purportedly available from individual tests, are collected and examined using established methods. As long as this does not happen, the discussion about potential damages from radiofrequency electromagnetic fields has no objective basis.

## Footnotes

<sup>1</sup> [http://vorort.bund.net/rheinland-pfalz/publikationen/publikationen\\_31/files/1102\\_arndts\\_vorgehenbeibluttestsinderpraxis.pdf](http://vorort.bund.net/rheinland-pfalz/publikationen/publikationen_31/files/1102_arndts_vorgehenbeibluttestsinderpraxis.pdf)

<sup>2</sup> All citations in this paragraph are taken from: ... by P. Germann, <http://www.die-umwelt-akademie.de/veranstaltungen/T54c.html>

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**Germann**, Peter, Dr., Mobilfunk und Gesundheit, 1. Teil „Gesundheitsrisiko elektromagnetischer Felder“, [http://www.izgmf.de/Einfluss\\_Mobilfunk\\_auf\\_Reticulocyten.pdf](http://www.izgmf.de/Einfluss_Mobilfunk_auf_Reticulocyten.pdf)

*Prof. Dr. Alexander Lerchl, International University of Bremen,  
School of Engineering and Science*